

# The Expert System Chapter 4



PHOTO BY DAN BURDEN

**How to use PEDSAFE  
Selection Tool  
Interactive Matrices**

**Countermeasures  
Case Studies**

The PEDSAFE expert system is provided on the enclosed CD and is available online at <http://safety.fhwa.dot.gov/pedsafe> and at [www.walkinginfo.org/pedsafe](http://www.walkinginfo.org/pedsafe). This chapter provides an overview of the application and specific instructions on how to access and use the tools available. The application is designed to:


- Provide information on the countermeasures available to prevent pedestrian crashes and/or improve motorist and pedestrian behavior.
- Highlight the purpose, considerations and cost estimates associated with each countermeasure.
- Provide a decision process to select the most applicable countermeasures for a specific location.
- Provide links to case studies showing the various treatments and programs implemented in communities around the country.
- Provide easy access to resources such as statistics, implementation guidance, and reference materials.

The expert system combines the resources provided in this document with online tools (see home page below) to enable practitioners to effectively select engineering, education, or enforcement treatments to mitigate a known crash problem or achieve a specific performance objective.

The resource materials included in the web/CD application are related to this document as follows:

<u>Web/CD Application</u>	<u>Print Document*</u>
Background	Chapter 1: The Big Picture
Crash Statistics	Chapter 2: Pedestrian Crash Statistics
Crash Analysis Objectives	Chapter 3: Selecting Improvements for Pedestrians
Implementation Publications	Chapter 7: Implementation and Resources

\*Chapters 5 and 6 include the countermeasures and case studies, which are available as *Tools* on the web/CD application.


Pedestrian Safety Guide and Countermeasure Selection System

The Pedestrian Safety Guide and Countermeasure Selection System is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and/or mobility based on user input about a specific location. [\[read more\]](#)

**Resources:**

**Background** – understand what is needed to create a viable pedestrian system.

**Crash Statistics** – learn about the factors related to the pedestrian crash problem.


**Crash Analysis** – learn how crash typing can lead to the selection of the most appropriate countermeasures.

**Objectives** – learn how selected treatments may address many requested improvements to the pedestrian environment.

**Implementation** – read about the necessary components for implementing pedestrian treatments.

**More Info** – access additional information through a variety of resources.

**Downloads** – access print versions of the guide and other relevant materials.

**Available Tools:** 

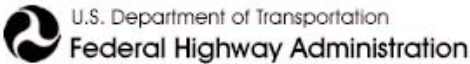
**Selection Tool** – find appropriate countermeasures on the basis of desired objectives and specific location information.

**Interactive Matrices** – view the countermeasures associated with crash types and performance objectives.

**Countermeasures** – read descriptions of the 49 engineering, education, and enforcement treatments.

**Case Studies** – review real-world examples of implemented treatments.

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The PEDSAFE web/CD application is organized into resources and tools.

## HOW TO USE PEDSAFE

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The remainder of this chapter focuses on the tools available on the web/CD application, which include:

- Selection Tool – This interactive tool allows the user to develop a list of possible countermeasures on the basis of site characteristics, such as geometric features and operating conditions, and the type of safety problem or desired behavioral change. The decision logic used to determine when specific treatments are and are not applicable is based on input from an expert panel of practitioners.
- Interactive Matrices – This tool shows the relationship between the countermeasures and the performance objectives or crash types and can be used to display applicable countermeasures.
- Countermeasures – Details of 49 engineering, education and enforcement treatments or programs for improving pedestrian safety and/or mobility are provided in the categories of pedestrian facility design, roadway design, intersection design, traffic calming, traffic management, signals and signs, and other measures.
- Case Studies – More than 70 real-world examples illustrate various treatments and/or programs as implemented in a state or municipality.

PEDSAFE is designed to allow the tools and information to be accessed from multiple points of entry. Links are provided to allow users to easily navigate between the tools and to quickly access the resource materials. Provided below are four examples of how a user may choose to enter the system and access the tools.

- 1) Selection Tool – The user may have information available about geometrics and operating conditions of a particular location and either has a specific type of crash problem or desires to change motorist/pedestrian behavior at the site. All of the known information may be entered by answering a series of questions. The system will then display the countermeasure options to be considered.
- 2) Interactive Matrices – The user has a specific type of crash problem or desires to change motorist/pedestrian behavior but does not have specific information about the characteristics of the site. The matrices can be used to view and access the types of countermeasures available for further consideration.
- 3) Countermeasures – The user is interested in acquiring information about a particular treatment or program. The countermeasures page can be directly accessed and displays the seven categories of treatments included. Detailed

descriptions of the 49 countermeasures can be accessed from this point. Links to relevant case studies can then be accessed from the description pages.

- 4) Case Studies – The user wishes to see specific examples of treatments that have been installed. The case studies page provides the option of selecting a specific implementation example by type of treatment or by location (State and municipality). From there, the user can access the countermeasure description pages that are relevant to a particular example.

Each of these tools is described in more detail in the remainder of the chapter.

## SELECTION TOOL

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The interactive selection tool allows the user to refine their selection of countermeasures on the basis of specific site characteristics and/or the type of safety problem or desired behavioral change. One begins by choosing *selection tool* from the *Tools* menu. A screen will appear with specific instructions on how to use the tool (*see next page*), which is a simple 3-step process:

*Step 1: Enter the Location*—A text box is provided for the user to describe the location of interest. In the figure on the next page, a specific intersection location—Main Street and Broadway Avenue—has been entered.

*Step 2: Select the Goal of the Treatment*—The user must then choose a particular type of crash problem to be mitigated or a performance objective to be achieved. As shown in the figure on page 41, there are 8 performance objectives and 12 crash groups. Only one can be selected. As the user proceeds through the steps, the previous input is shown on the right side of the screen. In this example, the roadway location that was previously entered is provided.

*Step 3: Describe the Site*—Finally, the user is asked to provide input about the characteristics of the site. As shown in the figure on page 40, there are seven questions that are asked in reference to the general location, geometric features, and operating conditions. The answers to these questions are used to narrow the list of appropriate countermeasures for a specific goal. For example, if the location of interest were roadway segment (midblock location), then the treatments associated with intersection improvements would not be applicable and would not be included in the results as applicable countermeasures.

## Selection Tool

### How the Tool Works

The selection tool is designed to receive input on several variables from the user in three steps.

#### 1 Choose the Location

First, enter the location of the site in question. This allows the user to create reports for several different sites and keep the results separated by location. It is used for reporting purposes only and is not stored permanently by the operators of this web site.

#### 2 Select the Goal of the Treatment

Second, one must decide on the goal of the treatment. It may either be to achieve a specific performance objective, such as reduce traffic volumes, or to mitigate a specific type of pedestrian-motor vehicle collision.

#### 3 Describe the Site

Once a specific goal has been selected, the third step is to provide answers to a series of questions related to the geometric and operational characteristics of the site in question. The answers to these questions are used to narrow the list of appropriate countermeasures for a specific goal. For example, if the location of interest were a segment of roadway, or midblock location, then the treatments associated with intersection improvements would not be applicable and thus, would not be included in the results as possible countermeasures.

For any question where the information is not known, an entry of "unknown" will simply retain the countermeasures relevant to the question, and the range of treatments will not be reduced.

#### Use the Selection Tool

[Start Here](#)

The *Selection Tool* includes three simple steps that are described on the opening page for the tool.

## Data Input

#### 1 Enter the Location

For the roadway location being addressed, please enter a description.

#### Location

Main Street and Broadway Avenue

[Proceed to Step 2](#)

The user may enter any combination of text and numbers to describe the location of interest.

The field investigation form included in Appendix A can be used for site visits to obtain the information asked for in this last step. For any question where the information is not known, an entry of “unknown/not applicable” will simply retain all countermeasures relevant to the question, and the choice of treatments will not be reduced.

After completing these three steps, the user clicks *Get Results*. The information entered is used to develop a list

of applicable countermeasures, which are presented as shown on page 41. The user can then read more about a specific countermeasure by selecting it, which takes the user to the countermeasure description page.

In addition to the applicable countermeasures, the results page also provides the user with a summary of the inputs made in the three steps. Options are provided for changing these inputs for the location of interest, exporting the results to Excel, or starting over with a new location.

[Home](#) > [Selection Tool](#) > [Step One](#) > Step Two

## Data Input

**2 Select One of the Following**

For the roadway location being addressed, the goal of the pedestrian treatment is intended to improve pedestrian safety and access by either achieving one of the following performance objectives **OR** mitigating one of the following crash types. Therefore, you must choose one of the following to begin.

<b>Performance Objectives</b>	<b>Crash Types</b>	<b>Your Input:</b> Roadway Location: <b>Main Street and Broadway Avenue</b>
<input checked="" type="radio"/> Reduce Speed of Motor Vehicles	<input type="radio"/> <a href="#">Dart/Dash</a>	
<input type="radio"/> Improve Sight Distance and Visibility	<input type="radio"/> <a href="#">Multiple Threat/Trapped</a>	<b>Next Steps:</b> <a href="#">Proceed to Step 3</a>
<input type="radio"/> Reduce Volume of Motor Vehicles	<input type="radio"/> <a href="#">Unique Midblock</a>	
<input type="radio"/> Reduce Exposure for Pedestrians	<input type="radio"/> <a href="#">Through Vehicle at Unsignalized Location</a>	
<input type="radio"/> Improve Pedestrian Access and Mobility	<input type="radio"/> <a href="#">Bus-Related</a>	
<input type="radio"/> Encourage Walking by Improving Aesthetics	<input type="radio"/> <a href="#">Turning Vehicle</a>	
<input type="radio"/> Improve Compliance with Local Traffic Laws	<input type="radio"/> <a href="#">Through Vehicle at Signalized Location</a>	
<input type="radio"/> Eliminate Behaviors that Lead to Crashes	<input type="radio"/> <a href="#">Walking Along Roadway</a>	
	<input type="radio"/> <a href="#">Working or Playing in Roadway</a>	
	<input type="radio"/> <a href="#">Non-Roadway</a>	
	<input type="radio"/> <a href="#">Backing Vehicle</a>	
	<input type="radio"/> <a href="#">Crossing an Expressway</a>	

A specific performance objective desired or crash type to be mitigated must be selected in step 2.

## Data Input

### 3 Answer the Following Questions

1. In what type of area is the roadway located?

- Urban CBD
- Urban Other
- Suburban
- Rural
- Not Applicable/Unknown

2. What is the functional class of the roadway?

- Local
- Collector or Minor Arterial
- Principal Arterial
- Not Applicable/Unknown

3. Is the problem at an intersection or midblock (roadway segment) location?

- Intersection
- Midblock
- Not Applicable/Unknown

4. What is the vehicle volume at this location (expressed in terms of average daily traffic (ADT) for the primary roadway)?

- <10,000
- >=10,000 and <= 25000
- > 25000
- Not Applicable/Unknown

5. Is vehicle speed low or high?

- <= 45 mph
- > 45 mph
- Not Applicable/Unknown

6. What is the number of through travel lanes (both directions)?

- 2 or fewer lanes
- 3 or 4 lanes
- 5 or more lanes
- Not Applicable/Unknown

7. Is a traffic signal present, being considered, or not an option?

- Present (Removal not an option)
- Present (Removal is an option or being considered)
- Not present (Installation is not an option)
- Not present (Installation is an option)
- Not Applicable/Unknown

#### Your Input:

Roadway Location:

Your Performance Objective:  
**Reduce Speed of Motor Vehicles**

#### Next Steps:

##### Edit:

[Change Your Performance Objective](#)

##### Start Over

[Get Results](#)

The characteristics of the location are provided in Step 3 by answering seven questions.

## Applicable Countermeasures

Based upon your input, the following countermeasures were found:

**Pedestrian Facility Design**  
[Street Furniture](#)

**Roadway Design**  
[Curb Radius Reduction](#)

**Intersection Design**  
[Roundabouts](#)

**Traffic Calming**  
[Curb Extensions](#)  
[Chokers](#)  
[Raised Intersections](#)  
[Raised Pedestrian Crossings](#)  
[Landscaping](#)  
[Specific Paving Treatments](#)

**Signals and Signs**  
[Signing](#)

**Other Measures**  
[School Zone Improvements](#)

### Your Input:

Roadway Location:  
**Main Street and Broadway Avenue**

Your Performance Objective:  
**Reduce Speed of Motor Vehicles**

Your answers to the previous questions:

Type of Area: **Suburban**  
Functional Class: **Collector or Minor Arterial**  
Intersection or Midblock:  
**Intersection**  
Volume: **Medium ( $\geq 10,000$  and  $\leq 25000$  ADT)**  
Speed: **Low ( $\leq 45$  mph)**  
No. of Lanes: **3 or 4 lanes**  
Traffic Signal: **Present (Removal is an option or being considered)**

### Next Steps:

#### Edit:

[Change Your Performance Objective](#)  
[Change Your Answers](#)

#### Save:

 [Output Results to Excel](#)

**Start Over**

The results produced from the Selection Tool provide a list of applicable countermeasures and present the user with options to edit the responses, save the results, or start over.

## INTERACTIVE MATRICES

Also included in the web/CD application are two matrices that may be accessed by selecting *interactive matrices* from the *Tools* menu. The objectives matrix (shown below) provides the user with a quick view of the relationship between the 8 performance objectives and the 7 countermeasure groups. The crash analysis matrix (shown on the following page) allows the user to see the relationship between the 12 crash type groups

and the 7 countermeasure groups. In either matrix, a filled cell indicates that there is a specific countermeasure within the countermeasure group (shown in the columns) that is applicable to the crash group or performance objective listed in each row. The user can click on the bullet in any filled cell to obtain a drop-down list of the specific applicable countermeasures. From there, the user can choose to select a countermeasure and be linked to the countermeasure description page or select another cell within the matrix.

[Home](#) > [Objectives](#) > Interactive Matrix

### Objectives

#### Interactive Matrix

Select an Objective and Countermeasure Group from the matrix below, or [view the text-only version](#).

Objective	Countermeasures						
	Pedestrian Facility Design	Roadway Design	Intersection Design	Traffic Calming	Traffic Management	Signals and Signs	Other Measures
1. Reduce Speed of Motor Vehicles	•	•	•	•		•	•
2. Improve Sight Distance and Visibility for Motor Vehicles and Pedestrians	•	•		•		•	
3. Reduce Volume of Motor Vehicles		•		•	•		
4. Reduce Exposure for Pedestrians	•	•		•		•	
5. Improve Pedestrian Access and Mobility	•	•		•		•	
6. Encourage Walking by Improving Aesthetics	•	•		•			•
7. Improve Compliance With Traffic Laws			•	•			•
8. Eliminate Behaviors That Lead to Crashes			•	•		•	•

Cells with a bullet indicate there are one or more countermeasures within a countermeasure group that are applicable to a specific performance objective.



## Crash Analysis

### Interactive Matrix

Select a Crash Group and Countermeasure Group from the matrix below, or [view the text-only version](#).

Crash Group	Countermeasures						
	Pedestrian Facility Design	Roadway Design	Intersection Design	Traffic Calming	Traffic Management	Signals and Signs	Other Measures
1. Dart/Dash	•	•		•	•	•	•
2. Multiple Threat/Trapped	•	•	•	•		•	•
3. Unique Midblock	•	•		•		•	•
4. Through Vehicle at Unsignalized Location	•	•	•	•	•	•	•
5. Bus-Related	•	•		•		•	•
6. Turning Vehicle	•	•	•	•	•	•	•
7. Through Vehicle at Signalized Location	•	•	•	•	•	•	•
8. Walking Along Roadway	•	•				•	•
9. Working or Playing in Roadway	•	•		•	•	•	•
10. Non-Roadway	•	•		•		•	•
11. Backing Vehicle	•	•		•			•
12. Crossing an Expressway	•					•	•

Cells with a bullet indicate there are one or more countermeasures within a countermeasure group that are applicable to a specific crash group.

## COUNTERMEASURES

Each of the 49 engineering, education, and enforcement countermeasures described in Chapter 5 are included in the web/CD application. After selecting *countermeasures* within the *Tools* menu, the user may select one of the following seven categories of treatments:

- Pedestrian Facility Design
- Roadway Design
- Intersection Design
- Traffic Calming

- Traffic Management
- Signals and Signs
- Other Measures








A specific countermeasure may then be selected from those listed for each category. Each countermeasure includes a description of the treatment or program, purpose(s), considerations that one should be aware of, and cost estimates. Finally, there is a link to specific case studies where the particular countermeasure has been implemented. An example countermeasure description page is shown on the following page for Curb Ramps.

[Home](#) > Countermeasures

## Countermeasures

### Engineering, Education and Enforcement

Read the details of 49 treatments for pedestrians as they relate to pedestrian facility design, roadway design, intersection design, traffic calming, traffic management, signals and signs, and other measures.

	<b><u>Pedestrian Facility Design:</u></b> It is a public responsibility to provide a safe, secure, and comfortable system for all people who walk.		<b><u>Traffic Calming:</u></b> Traffic calming is a way to design streets, using physical measures, to encourage people to drive more slowly.
	<b><u>Roadway Design:</u></b> The goal of an appropriately designed roadway should be to safely and efficiently accommodate all modes of travel, from pedestrians to bicyclists to motorists.		<b><u>Traffic Management:</u></b> Traffic management includes the use of traditional traffic control devices to manage volumes and routes of traffic.
	<b><u>Intersection Design:</u></b> The primary point of conflict and the most prevalent location for crashes between pedestrians and motor vehicles is the intersection.		<b><u>Signals and Signs:</u></b> Traffic engineers have an arsenal of signs and signals that can be used to regulate and warn both motorists and pedestrians.
			<b><u>Other Measures:</u></b> Engineers must be cognizant of the capabilities and needs of all pedestrians when designing a roadway or developing an operations plan.

The 49 countermeasures are divided among the 7 categories of improvements shown here.

## Curb Ramps:

Curb Ramps ▼

Curb ramps provide access between the sidewalk and roadway for people using wheelchairs, strollers, walkers, crutches, handcarts, bicycles, and also for pedestrians with mobility impairments who have trouble stepping up and down high curbs. Curb ramps must be installed at all intersections and midblock locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and ADA 1990). Curb ramps must have a slope of no more than 1:12 (must not exceed 25.4 mm/0.3 m (1 in/ft) or a maximum grade of 8.33 percent), and a maximum slope on any side flares of 1:10. More information on the specifications for curb ramps can be found in the *Draft Guidelines for Accessible Public Rights of Way*.<sup>4</sup>

Where feasible, separate curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks. This provides improved orientation for visually impaired pedestrians. Similarly, tactile warnings will alert pedestrians to the sidewalk/street edge. All newly constructed and altered roadway projects must include curb ramps. In addition, all agencies should upgrade existing facilities. They can begin by conducting audits of their pedestrian facilities to make sure transit services, schools, public buildings, and parks, etc. are accessible to pedestrians who use wheelchairs.

While curb ramps are needed for use on all types of streets, priority locations are in downtown areas and on streets near transit stops, schools, parks, medical facilities, shopping areas, and near residences with people who use wheelchairs.

For more information about curb ramp design, see *Designing Sidewalks and Trails for Access, Parts I and II*, by the Federal Highway Administration, and *Accessible Rights-of-Way: A Design Guide*, by the U.S. Access Board and the Federal Highway Administration. The Access Board's right-of-way report can be found at [www.access-board.gov](http://www.access-board.gov).

### Purpose

- Provide access to street crossings.

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### Considerations

- Follow Americans with Disabilities Act (ADA) design guidelines.
- Texture patterns must be detectable to blind pedestrians.

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### Estimated Cost

The cost is approximately \$800 to \$1,500 per curb ramp (new or retrofitted).

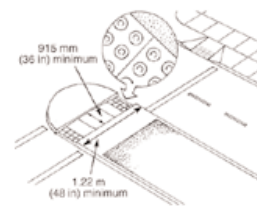
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### Case Studies

[Cambridge, MA](#)  
[Berkeley, CA](#)  
[Clemson, SC](#)  
[Albany, NY](#)  
[Grand Junction, CO](#)  
[Fort Plain, NY](#)  
[Austin, TX](#)  
[St. Petersburg, FL](#)

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- [view purpose](#)
- [view considerations](#)
- [view estimated cost](#)
- [view case studies](#)



[view](#)



Each countermeasure includes a description, purpose, considerations, estimated cost, and links to case studies where the treatment or program has been implemented.

## CASE STUDIES

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The 71 case studies described in Chapter 6 are included in the web/CD application. The user can access the implementation examples by selecting *case studies* within the *Tools* menu. As shown on the following page, the user then has the option of selecting a case study on the basis of location or type of countermeasure. The figure on the following page provides an example of selection by countermeasure. The selection of the *Traffic Calming* countermeasure group produces a list of the 14 traffic calming treatments included in the application. The selection of *Serpentine Design* produces a list of six case studies in which serpentine design was a component of the treatments implemented. Accessing each of these case studies provides information about the specific problem that was addressed, the solution implemented, and the results achieved.

## Choose a Case Study...

By Location or Countermeasure Group

### Location

- [Inside the United States](#)
- [Outside the United States](#)

### By Countermeasure Group

- [Pedestrian Facility Design](#)
- [Roadway Design](#)
- [Intersection Design](#)
- [Traffic Calming](#)
- [Traffic Management](#)
- [Signals and Signs](#)
- [Other Measures](#)

## Choose a Case Study...

By Location or Countermeasure Group

### Location

- [Inside the United States](#)
- [Outside the United States](#)

### By Countermeasure Group

- [Pedestrian Facility Design](#)
- [Roadway Design](#)
- [Intersection Design](#)
- [Traffic Calming](#)
  - [Curb Extensions](#)
  - [Choker](#)
  - [Crossing Islands](#)
  - [Chicanes](#)
  - [Mini-Circles](#)
  - [Speed Hump](#)
  - [Speed Table](#)
  - [Raised Intersection](#)
  - [Raised Pedestrian Crossing](#)
  - [Gateways](#)
  - [Landscaping](#)
  - [Specific Paving Treatments](#)
  - [Serpentine Design](#)
  - [Woonerf](#)
- [Traffic Management](#)
- [Signals and Signs](#)
- [Other Measures](#)

## Choose a Case Study...

- [Serpentine Designs](#)
  - [Leland Street Redesign](#)
  - [Main Street Redesign](#)
  - [Old Town Improvements](#)
  - [Red Light Photo Enforcement](#)
  - [Serpentine Street Design](#)
  - [Woonerf-Style Developments](#)

The case studies may be selected by location or by countermeasure. Opening a Countermeasure Group folder reveals the list of countermeasures included. Selecting a specific countermeasure reveals the case studies in which that treatment/program was a component.

